

**SIXTH FIVE-YEAR REVIEW REPORT FOR
VELSICOL CHEMICAL CORP. (MICHIGAN) SUPERFUND SITE
GRATIOT COUNTY, MICHIGAN**



Prepared by

**U.S. Environmental Protection Agency
Region 5
Chicago, Illinois**

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X Douglas Ballotti

Douglas Ballotti, Director
Superfund & Emergency Management Division
Signed by: DOUGLAS BALLOTTI

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LIST OF ABBREVIATIONS & ACRONYMS

ANP	Adjacent or Nearby Properties
ATSDR	Agency for Toxic Substances and Disease Registry
BEHP	bis (2-ethylhexyl) phthalate
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (1980)
CJ	Consent Judgment
COC	contaminant of concern
DBCP	1,2 dibromo-3-chloropropane
DDT	dichlorodiphenyltrichloroethane
DNAPL	dense non-aqueous phase liquid
EGLE	Michigan Department of Environment, Great Lakes and Energy
EPA	United States Environmental Protection Agency
FPS	Former Plant Site
FS	feasibility study
FTL	Fruit of the Loom
GAWA	Gratiot Area Water Authority
GWCS	groundwater collection system
HBB	hexabromobenzene
ICIAP	Institutional Control Implementation and Assurance Plan
ICs	Institutional Controls
ISCO	In-situ Chemical Oxidation
ISTT	In-situ Thermal Treatment
MCC	Michigan Chemical Corporation
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDPH	Michigan Department of Public Health
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NPL	National Priorities List
NWI	NWI Land Management, Inc.
O&M	operation and maintenance
OU	operable unit
PBB	polybrominated biphenyls
pCBSA	para-chlorobenzene sulfonic acid
PFAS	Per- and Polyfluoroalkyl Substances
PFAS	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	Point of Compliance
ppb	parts per billion
ppm	parts per million
PSA	Potential Source Area
RAOs	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986

Site	Velsicol Chemical Corp. (Michigan) Superfund Site
SMI	Source Migration Investigation
SVOCs	semi-volatile organic compounds
SWAC	surface-weighted average concentration
TCRA	Time Critical Removal Action
TI	Technical Impracticability
TRIS	tris(2,3-dibromopropyl) phosphate
UU/UE	unlimited use/unrestricted exposure
Velsicol	Velsicol Chemical Corporation
VOCs	volatile organic compounds

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The United States Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the sixth FYR for the Velsicol Chemical Corp. (Michigan) Superfund Site (Site). The triggering action for this statutory FYR is the completion date of the previous FYR. The FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of four operable units (OUs) and two OUs, OUs 1 and 2, will be reviewed and addressed in this FYR. Since the 2017 FYR, EPA has added an additional OU by dividing OU3 into two OUs. OU1 addresses the remediation of the Former Plant Site (FPS) and the nearby residential properties. OU2 addresses the sediments in the lower and middle basins of the St. Louis impoundment of the Pine River, which runs along the western and northern edge of the FPS to the St. Louis dam. The two OUs not addressed in this FYR are OU3 and OU4, since both do not have Records of Decision (RODs) selecting the remedies to be implemented for these OUs yet. OU3 is likely to address sediment, bank soils and floodplain soils from the St. Louis dam to floodplain 1.1 which is approximately 1.5 miles downstream from the dam. OU4 is likely to address sediment, bank and floodplain contamination from floodplain 1.2 to the confluence of the Pine and Chippewa Rivers.

The Velsicol Chemical Superfund Site FYR was led by Remedial Project Manager Thomas Alcamo. Participants included Erik Martinson from the Michigan Department of Environment, Great Lakes and Energy (EGLE) and EPA contractor Jacobs. The review began on 8/23/2021.

Site Background

The Site is located in Gratiot County, St. Louis, Michigan, and consists of four OUs (see Appendix C, Figures 1 & 2). OU1 consists of two sub-areas: (1) the 52-acre FPS located at 500 Bankson Street, which is the location of the former chemical manufacturing facility and is currently fenced on all sides to restrict access; and (2) the “adjacent or nearby properties” (ANP) which includes the residential neighborhood located south and east of the FPS. OU2 consists of contamination in the sediments and fish in the lower and middle basins of the St. Louis Impoundment of the Pine River, which runs along the western and northern edge of the FPS. The St. Louis Impoundment is created by the St. Louis dam, located east of the Site. The FPS is bordered on the west and the north by the Pine River, and on the east and south by residential neighborhoods. Approximately 3,800 people live within one mile of the Site, and approximately 10,000 people live within three miles of the Site.

The 52-acre FPS was used for industrial operations since the mid-1800s, including a lumber mill, oil refinery, salt plant, and chemical plant. Michigan Chemical Corporation (MCC) purchased the facility in 1935 and operated a chemical manufacturing business until 1977, when MCC merged with Velsicol

Chemical Corporation (Velsicol). From 1936 through 1977, the plant manufactured a variety of organic and inorganic chemicals including polybrominated biphenyls (PBB), hexabromobenzene (HBB), dichlorodiphenyltrichloroethane (DDT), and tris(2,3-dibromopropyl)phosphate (TRIS). The plant was closed in 1977 and decommissioning activities were initiated in 1978. The plant site represented a threat to public health, welfare, and the environment because of widespread contamination caused by poor waste management practices and direct discharges of process wastes to the adjacent Pine River. The Site was proposed for inclusion on the NPL on December 30, 1982 and appeared on the final NPL on September 8, 1983.

The current land use immediately adjacent to the FPS is residential. Land use across the Pine River (around the area of the former burn area) is a mixture of recreational (golf course) and residential land use. Some agricultural land use occurs along the Pine River downstream of the St. Louis dam a few miles out of town. The land uses described above for the areas surrounding the FPS are expected to continue in the future. Projected land uses for the FPS itself may be recreational after the OU1 remedy is implemented. As a result of the bankruptcies of the various companies who owned and/or operated the Site, the remedial actions are being primarily paid for by The Superfund Trust Fund. In January 2022, discussions began on the change in ownership of the former 52-acre chemical plant site. A Custodial Trust, which was created by a settlement agreement as part of the Fruit of the Loom bankruptcy, took ownership of the site in August 2002. Le Petomane III, Inc. has acted as the trustee of the Custodial Trust since its creation. As of July 2022, Le Petomane III, Inc. is in the process of finalizing documents and then transferring ownership of the Site to the State of Michigan Land Bank.

Additional Site background information and a Site chronology can be found in Appendix B.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Velsicol Chemical Corp. (Michigan)		
EPA ID: MID000722439		
Region: 5	State: MI	City/County: St. Louis/Gratiot County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	Has the site achieved construction completion? Yes , date of Preliminary Close-out Report 09/25/1992 (Note: This site was designated as a construction completion site, but additional remedies were later determined to be necessary, both for OU2 (the river) and OU1 (FPS). Additional investigations are underway downstream of the St. Louis dam and are referenced as OU3/OU4.	
REVIEW STATUS		
Lead agency: EPA		
Author name (Federal or State Project Manager): Thomas Alcamo		

Author affiliation: U.S. EPA Region 5
Review period: 8/23/2021 - 2/7/2022
Date of site inspection: 10/20/2021
Type of review: Statutory
Review number: 6
Triggering action date: 9/19/2017
Due date (five years after triggering action date): 9/19/2022

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

A large number of hazardous substances were produced and have been released from the Site, including dense non-aqueous phase liquids (DNAPL). Two types of DNAPL are present on the Site and both contain several chemical constituents. One type of DNAPL on-site contains very high concentrations of 1,2-dichloroethane mixed with a large number of identified and unidentified brominated compounds, including PBB, HBB, and 1,2-dibromo-3-chloropropane (DBCP). A second type of DNAPL present at the Site includes high concentrations of chlorobenzene mixed with DDT and its isomers dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethene (DDE). DNAPL is present in Site soils and groundwater and the constituents listed above would be considered the chemicals of concern (COCs) in both media. Groundwater also contains a by-product of DDT production called para chlorobenzene sulfonic acid (pCBSA) and would be considered a COC in groundwater. The COC associated with sediment within the Pine River is DDT.

The primary risk to humans is the direct contact threat including ingestion and dermal contact from soils on the Site. Fish tissue within the Pine River shows high concentrations of DDT from contaminated sediment and has produced an unacceptable risk due to ingestion of fish tissue. In the ANP, some limited locations showed unacceptable human health risk due to PBB in soils. Unacceptable risk is present to ecological receptors from contaminated soil ingestion, mainly to worm eating birds. Dead robins sampled from the ANP showed lethal concentrations of DDT and its isomers in robin tissue samples. Groundwater on-site also has shown unacceptable risk from both ingestion and dermal contact. The City of St. Louis drinking water supply contained pCBSA but at concentrations below the drinking water standard.

While the Remedial Investigation/Feasibility Study (RI/FS) for OU2 identified PBB, total DDT, and HBB as COCs, total DDT was the basis for the human health and ecological risk assessments because it was found at the highest concentrations in fish tissue and sediments. The concentrations of total DDT in the sediments presented unacceptable risk to human health and the environment from fish consumption (by both humans and fish-eating birds). Further information on the evaluation of the risk to human health and ecological receptors are contained in the following:

- *Remedial Investigation Report for OUI at the Velsicol Chemical Corporation Site, November 2006 (Weston. 2006)*
- *Remedial Investigation Addendum Report for OUI at the Velsicol Chemical Site, January 2009*

(Weston. 2009)

- *OU2 Streamlined Remedial Investigation, dated June 1998 (EPA. 1998)*

Response Actions

A number of pre-ROD activities have taken place at the Site. Appendix B describes a detailed Site history of pre-ROD activities and a Site chronology. Pre-ROD response actions include the following:

- A Consent Judgement (CJ) signed between EPA, the State of Michigan and Velsicol in December 1982 that called for the construction of a containment system consisting of a slurry wall surrounding the 52-acre site and a cap over the former chemical plant property (US District Court. 1982). Velsicol began implementation of the CJ remedy in January 1983 and completed construction of the containment system in 1984. Velsicol was also required to maintain groundwater levels within the containment system at the Site. However, Velsicol stopped maintaining groundwater levels in 1998.
- In June 1998, EPA signed an Action Memorandum for a time-critical removal action (TCRA) to remove DDT-contaminated sediments from the Pine River adjacent to the FPS (EPA. 1998). EPA began the TCRA on August 3, 1998 and completed it on October 20, 1999. Approximately 30,000 cubic yards of total DDT-contaminated sediment was excavated and disposed off-site using 3,000 ppm cleanup criteria.
- In 2002, EPA constructed a DNAPL/groundwater collection system (GWCS) as an interim action to address DNAPL and contaminated groundwater being released from the FPS area into the sediment excavation area of the Pine River. This system was added as part of the selected remedy in the OU1 2012 ROD (EPA. 2012) and is still in use. Approximately 20,000 gallons per week of contaminated groundwater is extracted and transported off-site for treatment.

OU2

EPA signed a ROD for OU2 on February 12, 1999 (EPA, 1999). The selected remedy for OU2 was a continuation of the work initiated by the 1998 TCRA and called for hydraulic modification of the Pine River, the excavation of sediments containing greater than 5 parts per million (ppm) total DDT, dewatering and water treatment with discharge to the Pine River, and disposal of the contaminated sediments in either a Resource Conservation and Recovery Act (RCRA) Subtitle D or Subtitle C landfill. The remedial action objectives (RAOs) identified in the 1999 ROD are as follow:

- Reduce DDT concentrations in fish and sediments in the St. Louis Impoundment to levels that would not present an unacceptable human health or ecological risk and would allow eventual elimination of existing fish consumption advisories.
- Prevent direct human contact with contaminated sediments.
- Prevent significant down river migration of contaminated sediments.
- Achieve compliance consistent with federal and state applicable or relevant and appropriate requirements for the Site.
- Comply with risk-based objectives defined by the risk assessment.

The 1999 ROD called for the excavation of sediments containing total DDT greater than 5 ppm but recognized that meeting the risk-based cleanup level for total DDT would require the removal of all the sediments within OU2. Due to DDT being collocated with other contaminants, addressing DDT will also

address the other site contaminants present in sediment.

OU1

The containment system remedy implemented at OU1 under the 1982 CJ was directed at stopping the migration of Site contaminants from the FPS into the environment. Due to the release of DNAPL from the FPS into the Pine River found during the OU2 sediment remediation, it was determined that the containment remedy installed by Velsicol under the CJ had failed. To address the failed remedy, EPA signed a ROD on June 22, 2012 for OU1 addressing the FPS and the ANP (EPA, 2012). The RAOs identified in the 2012 ROD are as follow:

- At the FPS, prevent ingestion, inhalation, and direct contact of site-related COCs in soil to human and ecological receptors using the Michigan Part 201 generic cleanup criteria for COCs.
- Prevent ingestion, inhalation, and direct contact of Site-related COCs in groundwater to human and ecological receptors. The Michigan Part 201 generic cleanup criteria for COCs will be used.
- Prevent the migration of Site-related COCs from unsaturated and saturated subsurface media to the groundwater or surface water beyond the point of compliance (POC). The POC is defined as the FPS boundary. The Michigan Part 201 generic cleanup criteria for COCs will be used.
- Reduce or eliminate future migration of Site-related COCs in the lower outwash unit groundwater beyond the POC. The Michigan Part 201 generic cleanup criteria for COCs will be used.
- Prevent concentrations of pCBSA greater than cleanup criteria, located at the WMW-30 well cluster, from migrating to the city water intake zones. The Michigan Part 201 generic cleanup criterion for pCBSA is 7,300 parts per billion (ppb).
- Restore groundwater beyond the POC and technical impracticability (TI) waiver zone to federal and state drinking water standards. The TI Waiver zone is delineated in the 2012 ROD as the till unit under the Pine River adjacent to the FPS.
- Reduce the ability of DNAPL to adversely impact the aquifer by reducing DNAPL mass and mobility.
- Eliminate offsite migration of DNAPL to prevent the contamination of the surface water and recontamination of sediments of the Pine River.
- At the ANP, prevent ingestion, inhalation, and direct contact of Site-related COCs in soil to human and ecological receptors. The Michigan Part 201 generic cleanup criteria for COCs will be used.
- At the ANP, prevent mobilization of Site-related COCs from unsaturated soils to groundwater or surface water.

The remedy components selected in the 2012 ROD are as follow:

- Installation of a vertical barrier surrounding the FPS to decrease the potential for DNAPL and dissolved-phase contaminants to directly discharge to the Pine River from the shallow unit.
- Installation of a perimeter drain system to capture contaminated groundwater from the shallow unit for treatment and to maintain an inward hydraulic gradient.
- Continued operation of the existing GWCS to capture DNAPL and contaminated groundwater migrating from the shallow unit and prevent recontamination of the Pine River and sediments.

- Installation, if needed, of an additional (new) DNAPL/GWCS segment to address possible DNAPL and groundwater contamination from the MW-19 area, if needed.
- Implementation of in-situ thermal treatment (ISTT) system to address the two DNAPL-contaminated areas. The ISTT system would be operated until the maximum practical volume of DNAPL, based on diminishing returns evaluation, is achieved. The primary objective for ISTT implementation is to reduce the potential for mobile DNAPL within the FPS to recontaminate the sediments of the Pine River and prevent migration into the lower unit.
- Collection of DNAPL in the lower unit (100 feet below ground surface) near the WMW-48 location through the use of a collection sump and transportation of collected fluids offsite for incineration.
- In-situ chemical oxidation (ISCO), or excavation with offsite disposal, of up to four potential source areas (75,090 cubic yards). Two potential source areas will be excavated (42,939 cubic yards) to the soil saturation concentration for soils (C_{sat}) with subsequent offsite disposal. Two potential source areas (32,151 cubic yards) with groundwater contamination greater than respective water solubility concentrations will be treated by ISCO until the concentrations of COCs are below their respective water solubility concentrations.
- Installation of an engineered cap over the FPS meeting the requirements of RCRA Subtitle C and Michigan Part 111 to eliminate the direct contact threat and prevent infiltration.
- Replacement of the City of St. Louis, Michigan, municipal water supply to avoid increased, non-cost-effective long-term groundwater extraction and treatment costs.
- Restoration of groundwater to drinking water standards outside the POC and TI waiver zone, and containment within the POC through groundwater extraction and treatment.
- Excavation and offsite disposal of soils exceeding 5 ppm total DDT; 1.2 ppm PBB; and 4.4 ppm TRIS in the ANP to address risk to human health and the environment. Excavated properties will be backfilled with clean fill and restored.
- Monitoring well installation and groundwater monitoring program.
- Site restoration.
- Institutional controls (ICs) such as a restrictive covenant on the FPS to ensure that only industrial or recreational development occurs, an ordinance or other groundwater use restrictions restricting groundwater use at and near the FPS, continuing fish advisories for the Pine River issued by the Michigan Department of Community Health (MDCH) and adjusted as appropriate based upon sampling data, and appropriate signage warning that the site contains hazardous materials.

Table 1: Summary of Soil and Groundwater Cleanup Levels

Remedy Component	Soil Cleanup Levels	Groundwater Cleanup Levels
Excavation of soils in the ANP	Total DDT – 5 ppm; PBB – 1.2 ppm; TRIS – 4.4 ppm ¹	

¹ EPA used 4.1 ppm as a cleanup criterion for Total DDT to ensure we were 95% confident meeting the 5 ppm cleanup criteria

ISTT	Removal of Mobile NAPL; Michigan Part 201 Csat ²	
Excavation of Potential Source Area 1 & 2	Removal of Mobile NAPL; Csat ³	
ISCO of Potential Source Area 3 and 4		Michigan Part 201 water solubility criteria ⁴
Groundwater Treatment		Restore groundwater to MCLs outside of the point of compliance (POC) (former plant site boundary) and contain groundwater within the POC. Discharge of treated groundwater under an EGLE Substantive Discharge Requirement Document.

Status of Implementation

The Site achieved “construction completion” with the signing of the Final Close-out Report on 9/25/1992 (EPA. 1992). The initial remedy of the containment system was implemented by Velsicol Chemical in 1984. Due to Velsicol being released from liability for contaminated sediments in the 1982 CJ, EPA began a TCRA in June 1998 to address contaminated sediments adjacent to the FPS and Pine River Mill Pond (See Appendix C, Figure 2). Remedial action for OU2 began shortly after completion of the TCRA and was completed in 2006. The RA is documented in the *Remedial Action Report (CH2M. 2010)*. During the cleanup, EPA removed 4,355 gallons of DNAPL and excavated and disposed of approximately 670,000 cubic yards of contaminated sediment in a permitted offsite landfill. Following excavation, sediment bed confirmation samples were collected. The 5-ppm cleanup level for DDT was achieved throughout, except in a few areas where additional excavation could not be conducted and maintain the structural stability of the containment structure. These areas were capped with 2 feet of clay. See Appendix B for a more complete discussion of the remediation.

During the OU2 sediment cleanup, contaminated sediments greater than the 5 ppm DDT cleanup level were also not removed in an area of the river known as “Area 2.” Area 2 is located along the southern edge of the river from just west of the Mill Street Bridge to the dam at the southeastern portion of the Pine River Mill Pond. This is a relatively small area of the entire system, with less than 4% of the material exceeding the cleanup level and only 0.4% of the OU’s contaminant mass. Sample results showed that this area contained lesser concentrations of DDT contamination than most of the excavation

² Csat is a concentration for various constituents in Michigan Part 201 that may represent at that concentration the presence of NAPL.

³ During Predesign studies it was determined that within PSA 1 the COCs would be chlorobenzene at concentrations greater than 260,000 ppb and xylene at 150,000 ppb (both Csat concentrations with Part 201). Within PSA 2, the COCs would be chlorobenzene at 260,000 ppb and TRIS at 27,000 ppb.

⁴ Michigan Part 201 water solubility criteria are concentrations which may represent a NAPL. During Predesign studies it was determined that within PSA 3 the COCs would be DDT at concentrations greater than 25 ppb in water and hexabromobenzene at concentrations greater than 0.17 ppb in water. Within PSA-4 the predesign investigation determined that bis (2-ethylhexyl) phthalate (BEHP) was the COC at concentrations greater than 340 ppb in water.

area and, due to possible damage to the St. Louis hydroelectric dam, it was determined not to remove this sediment. As a result, Area 2 was excluded from the cleanup. The average surficial DDT concentration in Area 2 is 13.8 ppm, and the average concentration for the entire sediment column is 15.7 ppm total DDT. An estimated 26,000 cubic yards of sediments remain in Area 2. Taking into consideration the DDT that remains in Area 2, the total DDT Surface-area Weighted Average Concentration (SWAC) for all of OU2 was determined to be 1.38 ppm.

In 2015, EPA began a TCRA in the high school athletic fields, downstream from the St. Louis dam, in which 828 tons of DDT contaminated soils were excavated and disposed off-site. The cleanup criterion was 5 ppm total DDT and the cleanup was completed in 2016.

Shortly after signing the 2012 OU1 ROD, several pre-design and design tasks were completed or are currently underway by EPA for the implementation of the OU1 remedy. Pre-design investigations and remedial designs that are underway or have not started are listed below:

- Predesign investigation including treatability studies for potential source areas 3 & 4 (ongoing).
- Remedial design for the treatment of potential source areas 3 & 4 through ISCO (not started).
- Pre-design investigation and remedial design for installation of the perimeter drain to capture shallow groundwater for treatment (ongoing).
- Predesign investigation and remedial design/groundwater modeling for the groundwater pump and treatment system (ongoing).
- Predesign investigation for an additional groundwater collection trench, if needed (ongoing).
- Predesign investigation and remedial design for the construction of a vertical barrier wall (ongoing).
- Remedial design for the construction of an engineered cap (not started).

EPA implemented the remedial action for the residential cleanup of the ANP and it was completed in 2016. The cleanup criteria for DDT, PBB and TRIS were all met. Over 40,000 tons of DDT and PBB contaminated soil was excavated and disposed offsite from 111 properties. Documentation for the completion of the ANP cleanup can be found in the *Phase 1 and Phase 2 Remedial Action Report for the Adjacent and Nearby Properties, June 2016 (CH2M. 2016)* and *Phase 3 Remedial Action Report for the Adjacent and Nearby Properties, September 2016 (CH2M. 2016)*.

Remedial action for the replacement of the City of St. Louis, Michigan's municipal drinking water supply began in May 2014. Prior to beginning the drinking water replacement, St. Louis formed a joint water authority with the City of Alma called the Gratiot Area Water Authority (GAWA). The drinking water replacement was implemented by the City of St. Louis with EPA oversight of the construction. Most of the construction for the replacement of the drinking water supply was completed by October 2015. At that time, EGGLE allowed the City of St. Louis to connect to the GAWA drinking water supply since only the installation of one raw water supply well #12 and the associated transmission main was incomplete. The construction of well #12 and transmission main is ongoing and is expected to be completed by the fall of 2022.

On the FPS, ISTT of two areas was completed in early 2022. Over 4 acres were treated in three phases (Area 1, Area 2-Phase 1, Area 2-Phase 2) by ISTT. Area 2 required two phases to complete due to the required electricity demand. Over 382,000 pounds of contaminants were removed from soil and groundwater during the ISTT. The Remedial Action Report for Area 1 can be found in the *Remedial Action Report for the In-situ Thermal Treatment of Area 1 (ISTT) at the Velsicol Chemical Superfund*

site, dated March 2019 (CH2M. 2019). The Remedial Action Report for Area 2 is currently under development.

EPA is currently in the process of procuring a contractor for the excavation and offsite disposal of approximately 100,000 tons from PSA 1 & 2. This excavation with offsite disposal is expected to be completed sometime in 2024.

EPA continues to operate the DNAPL/GWCS that was installed in 2002 during the OU2 remediation. Approximately 20,000 gallons per week of contaminated groundwater is pumped from the collection trenches and shipped offsite for treatment. Eventually this water will be treated onsite in the future onsite water treatment plant that will be constructed as part of the remedial action. DNAPL is removed from the system manholes, when necessary, but DNAPL production has greatly reduced, and November 2016 was the last DNAPL removal event.

Since the last FYR, planning for several predesign investigations is underway for the upcoming remedies at the FPS that are discussed in further detail below:

1. Vertical Barrier Wall

A vertical barrier wall consisting of sealable sheet piling is scheduled to be installed within the current site slurry wall and surround the boundary of the 52-acre FPS. The downgradient vertical barrier will assist in the prevention of contaminated groundwater in the shallow unit from leaving the site into the Pine River and the upgradient vertical barrier wall will prevent uncontaminated groundwater from entering the site from the shallow unit. Additional groundwater entering the site could potentially increase the cost of groundwater treatment due to additional water being treated. Based on groundwater elevation data and the initial investigation results, EPA and EGLE continue the investigation of the upgradient slurry wall. The primary purpose of this investigation is to determine if the upgradient slurry wall is still effective as a groundwater flow barrier. This investigation is ongoing, and the initial work was described in the *CH2M Upgradient Slurry Wall Investigation Work Plan*, dated August 28, 2019 (CH2M. 2019). The results were presented in the *CH2M Data Evaluation Report for the Upgradient Slurry Wall Investigation*, dated August 2020 (CH2M. 2020) and *CH2M Technical Memorandum for Groundwater Monitoring*, dated August 31, 2020 (CH2M. 2020). Initial results of the investigation show a breach within the upgradient slurry wall with the majority of the upgradient slurry wall acting as a barrier to offsite groundwater flowing onto the site. Further investigation is underway through the *Supplemental Upgradient Slurry Wall Investigation*, dated February 16, 2022 (CH2M. 2022). Once additional information is available regarding the supplemental investigation, the existing groundwater flow model will be updated and used to evaluate groundwater flow onto the FPS under three modeling scenarios: (1) current site conditions; (2) with the installation of a vertical barrier wall; and (3) after repair of the slurry wall breach. Based on the results of the investigation and engineering evaluation, a determination will be made regarding the upgradient vertical barrier wall installation options sometime in 2023.

2. Additional DNAPL/Groundwater Collection Trench

The 2012 ROD discusses the possibility of adding a second DNAPL/GWCS trench within the Pine River on the west side of the Site near monitoring well MW-19. The investigation is described in the *CH2M MW-19 Investigation Work Plan*, dated February 2022 (CH2M. 2022). The purpose of the investigation is to determine if mobile NAPL is present in the shallow unit near MW-19 and assess the

potential for release from the site into the Pine River. Additional phases of investigation work may be required to fully assess conditions in this area of the Site and, if required, a determination regarding the need for installation of a second DNAPL/GWCS trench will be made sometime in 2023.

3. Perimeter Drain

A pre-design investigation for the installation of the perimeter drain is underway. The purpose of the perimeter drain is to collect contaminated groundwater from the shallow unit and ensure an inward hydraulic gradient to contain contaminated groundwater and prevent it from leaving the FPS. The perimeter drain investigation will initially consist of a series of soil borings around the site at the possible location of the drain. This information will assist in determining waste disposal requirements for soils that will be excavated during the installation of the perimeter drain and assist in determining the correct alignment. The pre-design investigation is described in the *CH2M Investigation Work Plan for the Perimeter Drain*, dated May 2022 (CH2M. 2022). Based on the results of this pre-design investigation, additional investigation may be required prior to developing the remedial design.

4. Potential Source Area 3 and 4

Pre-design investigations for the use of ISCO at two potential sources are underway. Initial investigations were documented in *Data Evaluation Report for Potential Source Areas 3 and 4* (CH2M. 2016), dated May 2016. In PSA 3, DDT at concentrations greater than 25 ppb in water and HBB at concentrations greater than 0.17 ppb in water were discovered during the investigation. A *Technical Memorandum Recommending the Design Approach for Potential Source Area 3*, dated June 8, 2020 (CH2M. 2020) was developed and additional work is scheduled for the summer of 2022 and includes collection of soil and groundwater samples to determine the natural oxidant demand and potential oxidant efficiency for DDT and HBB. In PSA 4, a *Technical Memorandum for the Evaluation of the Applicability for the Implementation of ISCO Treatment Technology in PSA-4*, dated June 8, 2020 (CH2M. 2020), was completed. One sample of BEHP below the shallow unit treatment zone was greater than the EGLE water solubility criteria of 340 ppb. The sampling shows all results except the one sample within the Site till unit as less than the cleanup criteria. Therefore, the investigation of PSA 4 shows that further treatment in that area of the Site is not necessary but additional groundwater sampling will verify the results.

5. Groundwater Pump and Treatment

Pre-design investigations are underway for the design of the groundwater pump and treatment system. Contaminated groundwater extracted from the shallow unit from the perimeter drain will be treated in an onsite water treatment plant. Contaminated groundwater from the lower unit will be contained within the Site boundary and treated onsite. Groundwater outside of the POC will also require treatment if the contaminants are greater than the MCLs. Additional investigation is underway and the most recent sampling results are documented in the *Technical Memorandum for Supplemental Groundwater Characterization*, dated January 22, 2021 (CH2M. 2021). In addition, a groundwater flow model has been developed and is documented in the *Final Report for the Velsicol Flow Model – 2016 update*, dated July 2017 (CH2M. 2017). The groundwater model is currently being updated with the most recent groundwater data from the upgradient slurry wall investigation and groundwater sampling events. Additional data will be obtained to further design the groundwater pump and treatment system and the extraction system for the MW-48 area.

Institutional Controls

ICs are non-engineered instruments, such as administrative and/or legal controls, that help minimize the potential for exposure to contamination and protect the integrity of the remedy. Compliance with ICs is required to assure long-term protectiveness for any areas which do not allow for UU/UE.

The Velsicol site requires ICs for both soil and groundwater. EPA is in the early stages of remediation on the FPS and has not begun the development of the ICs. EPA, the U.S. Department of Justice, EGLE, and the Michigan Attorney General are in the final stages of dissolving the Custodial Trust formed out of the Velsicol bankruptcy (with Le Petomane III, Inc. as trustee). Ownership of the Velsicol site, including the Velsicol Burn Pit and other properties, is in the process of being transferred to the State of Michigan Land Bank. EPA has funded a redevelopment study and the City of St. Louis, as part of its recreational plan, put forth a plan for what the city envisions future development might be at the Velsicol site. The change in ownership to the State of Michigan Land Bank should not change any future redevelopment plans for the FPS. As part of the final remedy, an engineered soil cap will be placed over the FPS to prevent infiltration and direct contact to hazardous materials. Any redevelopment shall not be allowed to disturb the integrity of the remedy or influence the protectiveness of the Site remedy. Also, any new groundwater pumping wells shall not be installed from within the City limits if the withdrawal influences the EPA groundwater pump and treatment system. Outside of the boundaries of the FPS, EPA will be working with the City of St. Louis on the development of an ordinance to prohibit any new groundwater withdrawal that may influence the performance of the groundwater pump and treatment system.

A summary of the planned ICs for the Site is listed in Table 2. Maps which depict the current conditions of the Site and areas which do not allow for UU/UE will be developed as part of the IC follow-up actions discussed below.

Table 2: Summary of Planned and/or Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Soil	Yes	Yes	State of Michigan Land Bank - FPS area	No development which disturbs the integrity of the remedy or influences protectiveness of the site remedy	Environmental Restrictive Covenant (ERC) (planned)
Groundwater	Yes	Yes	State of Michigan Land Bank – FPS area	Groundwater use restriction	ERC (planned)

Groundwater	Yes	Yes	City incorporated area surrounding the FPS area	Groundwater use restriction	City Ordinance (planned)
Pine River – Fish	Yes	Yes		Prevent over consumption of contaminated fish	State issued fish consumption advisories for the Pine River from the FPS to the Chippewa River: https://www.michigan.gov/-/media/Project/Websites/mdhhs/Folder2/Folder70/Folder1/Folder170/MDCH_EAT_SAFE_FISH_GUIDE_-_SOUTHEAST_MI_WEB.pdf?rev=1226fe9fe87c43d0b24ba48ee5423b88

Status of Access Restrictions and ICs:

Other than the state issued fish consumption advisories already in place for Pine River, no other ICs have been developed yet because the new cleanup actions pursuant to the OU1 ROD are just beginning and it is expected to take several years before all the remedy components, including the final engineered cap, are implemented at the FPS. The City of St. Louis has not begun drafting an ordinance to prevent any new groundwater withdrawal near the former Velsicol plant site within the city limits, but EPA will follow up with the City to discuss the process once the replacement of the City drinking water supply is completed in the fall of 2022. Access to the Site is restricted by two locked gates and fencing surrounding the 52-acre FPS area.

Current Compliance:

Even though the ICs have not been implemented, there are currently no known uses of the Site which would be considered inconsistent with the objectives to be achieved by the future ICs. Year-round occupancy of the Site by EPA’s contractors along with frequent site visits by EPA and EGLE help ensure that no use of the Site occurs which is inconsistent with the objectives of future ICs. The MDCH has installed bilingual signs along access points to the Pine River to advise about the no consumption fish advisory.

IC Follow up Actions Needed:

An Institutional Controls Implementation and Assurance Plan (ICIAP) will be developed which describes the plan for ensuring that all required ICs at the Site are implemented, and for ensuring that all ICs, once implemented, are monitored and maintained. The purpose of the ICIAP is to document the additional IC evaluation activities that will be conducted to ensure that the implemented ICs are

effective and to ensure that long-term stewardship procedures are put in place so that all ICs, once implemented, are properly maintained, monitored, and enforced. IC evaluation activities will include, as needed, evaluating the effectiveness of the ICs, developing updated maps depicting current conditions in areas that do not allow for UU/UE, reviewing current zoning and city ordinances, and reviewing recording and title work for properties impacted by the Site.

Long-Term Stewardship:

Since compliance with ICs is necessary to assure the protectiveness of the remedy, planning for long-term stewardship is required to ensure that the ICs are maintained, monitored, and enforced so that the remedy continues to function as intended. Long-term stewardship involves assuring effective procedures are in place to properly maintain and monitor the Site. Long-term stewardship will ensure effective ICs are maintained and monitored and the remedy continues to function as intended with regard to ICs. Procedures will be developed as part of the ICIAP to ensure that the implemented ICs will be properly maintained, monitored, and enforced.

Systems Operations/Operation & Maintenance

Excluding the winter months due to the system freezing, EPA continues to operate the DNAPL/GWCS, from which approximately 20,000 gallons of contaminated water are removed weekly from the trench and shipped to an approved facility offsite for treatment. When the onsite water treatment plant that will be constructed in the future becomes operational, the water from the DNAPL/GWCS will remain onsite for treatment. During the operation of the ISTT, the operation of the DNAPL/GWCS continued but portions of the underground piping of the collection system was damaged due to the thermal treatment system. This piping is scheduled to be repaired in the summer 2022. In addition, some settlement of the area around manhole 1 has occurred and this repair is scheduled to begin in the summer 2022. These maintenance issues have not impacted the operation of the DNAPL/GWCS and approximately 20,000 gallons of contaminated water continues to be removed for off-site treatment.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the current status of those recommendations.

Table 3: Protectiveness Determinations/Statements from the 2017 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Not Protective	<p><i>Protectiveness Statement:</i> The remedy at OU1 is not protective because only a portion of the Site remedy has been implemented. The residential ANP cleanup and the City of St. Louis change to the Gratiot Area Water Authority drinking water supply is complete, but other remedy components have not begun. The following actions need to be taken to ensure protectiveness: develop and submit an ICIAP; implement ICs; and full implementation of the remedy components listed below:</p> <ul style="list-style-type: none"> • Treatment of Area 1 and Area 2 of the FPS by ISTT • Excavation of PSAs 1 and 2 at the FPS

		<ul style="list-style-type: none"> • ISCO for PSAs 3 and 4 at the FPS • Installation/evaluation of a second DNAPL/groundwater collection trench • Installation of a vertical barrier wall surrounding the FPS • Installation of a groundwater pump and treatment system • Installation of an engineered cap over the FPS • Development of a long-term monitoring program
2	Short-term Protective	<p>The remedy at OU2 currently protects human health and the environment because removal of contaminated sediments in the Pine River and the installation of a collection trench system adjacent to the river has resulted in the successful attainment of the specified total risk-based sediment cleanup level, which should result in safe DDT levels in fish and eventual elimination of the existing fish consumption advisories. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: develop and implement a long-term monitoring plan for DDT levels in fish tissue and sediment; develop and submit an ICIAP; and implement ICs.</p>
Sitewide	Not Protective	<p>The remedy at the Site is not protective because only a portion of the OU1 remedy has been implemented. The residential ANP cleanup and the City of St. Louis change to the Gratiot Area Water Authority drinking water supply is complete, but other remedy components have not begun. The following actions need to be taken to ensure protectiveness: develop and submit an ICIAP; implement ICs; and full implementation of the remedy components listed below:</p> <ul style="list-style-type: none"> • Treatment of Area 1 and Area 2 of the FPS by ISTT • Excavation of PSAs 1 and 2 at the FPS • ISCO for PSAs 3 and 4 at the FPS • Installation/evaluation of a second DNAPL/groundwater collection trench • Installation of a vertical barrier wall surrounding the FPS • Installation of a groundwater pump and treatment system • Installation of an engineered cap over the FPS

Table 4: Status of Recommendations from the 2017 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	OU1 ROD has not been fully implemented	Continue to complete RD and RA for all the remedy components	Considered But Not Implemented	The residential cleanup of the ANP and in-situ thermal treatment are complete. The replacement of the City of St. Louis municipal drinking water is nearly complete, and EPA expects the excavation of PSA 1 and 2 to begin in the summer of 2022. RDs are underway for additional remedy components and RAs will follow as RDs are completed.	NA
2	Long-term monitoring of DDT levels in fish and sediment adjacent to the Site and in the St. Louis Impoundment	Develop and implement a long-term monitoring plan for DDT levels in fish tissue and sediment	Ongoing	The long-term monitoring program will be developed once EPA is farther into the FPS cleanup.	
1,2	An ICIAP is needed to ensure that effective ICs are implemented, monitored and maintained	Develop and submit an ICIAP which describes the plan for ensuring that all required ICs at the site are implemented, and for ensuring that all ICs, once implemented, are monitored and maintained	Ongoing	The ICIAP will be developed once the EPA is farther into the FPS cleanup.	
	ICs are needed	Implement ICs	Considered But Not Implemented	ICs will be recorded prior to the completion of construction engineered cap.	

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by a newspaper posting in the *Morning Sun* on May 15, 2022, May 16, 2022, May 17, 2022, and May 18, 2022 stating that there was a FYR and inviting the public to submit any comments to EPA. In addition, a number of community interviews were completed, and a series of questions were asked regarding the Velsicol cleanup. This information will be used to formulate future community outreach and assist in the development of the revised Community Involvement Plan in the fall of 2023. Overall, the individuals interviewed seemed pleased with the progress of the cleanup but have concerns regarding the residential cleanup and ongoing investigations.

More detailed information and a summary of the community interviews can be found at the Velsicol Chemical Superfund Site web page, located at the following address:

[CONSENSUS BUILDING INSTITUTE - VELSICOL SUPERFUND SITE, FINDINGS FOR THE FIVE-YEAR REVIEW \(epa.gov\)](https://www.epa.gov/velsicol-superfund-site)

EPA and EGLE attend a majority of the monthly Pine River Superfund Citizens Task Force meetings to provide an overview of the investigation, design and construction activities ongoing at the FPS. In addition, EPA meets periodically with the Saginaw Chippewa Tribe to provide them an update on Site activities.

Data Review

Fish tissue sampling has shown a dramatic decrease in total DDT concentrations after the OU2 sediment cleanup as described in the Fact Sheet titled *Pine River Fish Monitoring – Community Information Update, dated May 2014 (CH2M. 2014)*. Even though a dramatic decrease in total DDT in fish tissue has occurred, EGLE continues to maintain a fish consumption advisory for the Pine River within the St. Louis impoundment and downstream of the St. Louis dam due to the possible releases occurring at the FPS into the Pine River. EGLE has completed fish tissue sampling on approximately a five-year cycle that has included the St. Louis impoundment and downstream of the St. Louis dam. In 2018, EGLE also sampled resident fish in OU2 for DDT, but EPA has not been able to obtain these data. The latest fish tissue sampling results from 2018 are available for mercury and per- and polyfluoroalkyl substances (PFAS) in Appendix D. Sampling of fish tissue adjacent to the Site has shown no PFAS concentrations greater than 9 ppb, which is the Michigan Department of Health and Human Services screening level. In addition, EGLE has completed caged fish studies for total DDT as shown in Table 4. Results have shown a large decrease in total DDT concentrations in caged fish. After the remaining source control actions from OU1 into the Pine River are addressed, EPA or EGLE will conduct comprehensive (and long-term, as necessary) monitoring to determine attainment of acceptable fish tissue COC concentrations.

Table 4: Lipid Normalized Total DDT in Caged Fish Tissue in ug/g (ppm)

Location	Sample Year				
	1999	2000	2002	2007	2017
M-46 - Upstream	0.02	0.01	0.009		No quantifiable uptake (NQU)
Impoundment		0.28			0.006
Downstream of Dam	0.73	0.68	0.2	0.68	0.03

In 2023, EGLE will be completing fish tissue sampling for DDT in the St. Louis Impoundment and Mill Pond area and EPA will be completing fish tissue sampling for DDT downstream of the St. Louis dam. Once all sampling results have been received, EPA will evaluate DDT trends in fish tissue using this data and the 2018 data if it is provided to EPA by EGLE.

Site Inspection

The inspection of the Site was conducted on 10/20/2021. In attendance were Thomas Alcamo from EPA, Erik Martinson from EGLE, and Scott Pratt from Jacobs. The purpose of the inspection was to assess the protectiveness of the remedy.

During the inspection, the final phase of ISTT was underway. The Site was well maintained, and the Site roads and fence were in good shape. Both Site gates are in use and large truck traffic are required to use the gate off M-46. Gates are locked at the end of the workday.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

OU1: No. The original containment remedy is not functioning as intended by the 1982 CJ and is no longer protective of human health and the environment. The ROD signed on June 22, 2012, addresses the failed 1982 remedy. EPA and EGLE continue to implement the remedy components for OU1 as funding becomes available. The residential cleanup of the ANP and the ISTT are complete. The replacement of the City of St. Louis municipal drinking water supply is nearly complete, but St. Louis has shut down its municipal drinking water wells and has now converted to using GAWA drinking water. EPA continues to operate the DNAPL/GWCS, which collects 20,000 gallons of contaminated groundwater weekly for offsite treatment and disposal. The DNAPL/GWCS does not operate in the winter months, but the contaminated groundwater will be treated in the on-site groundwater treatment plant once it is constructed. Further, access to the Site is restricted by two locked gates and fencing surrounding the 52-acre FPS area. EPA is expecting a funding increase for both RD and RA which should accelerate the remediation. EPA and EGLE expect the remedy for OU1 to be protective once all the remedy components, including ICs, are completed.

OU2: Yes. All materials exceeding the cleanup levels that could be removed were successfully removed and attainment of cleanup levels in the excavated areas was verified (or contaminant residuals were capped). Fish tissue data (the human health risk driver and focus of the sediment related RAO) have shown a dramatic decrease since the start of the OU2 sediment cleanup in 1997. EGLE conducts fish tissue monitoring every five years and these data will be used to assess effectiveness. In addition, when the releases from the FPS are addressed, a monitoring program to ascertain RAO achievement will be developed and implemented. Due to these potential releases into OU2 from the FPS, even with the decrease in DDT levels in fish tissue, the State of Michigan has placed a fish consumption advisory for the Pine River for the St. Louis Impoundment, Mill Pond and downstream of the St. Louis dam.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes. The OU1 ROD was signed on June 22, 2012, and the toxicity data, cleanup levels, risk assessment methods and RAOs are still valid. In addition, no changes in exposure pathways have occurred. At the request of EGLE and the likelihood EGLE will add PFAS to the future substantive water treatment plant discharge requirements, future groundwater sampling will include PFAS. Sampling of fish tissue adjacent to the Site has shown no PFAS concentrations greater than 9 ppb, which is the Michigan Department of Health and Human Services screening level. EPA at the request of EGLE will be including PFAS sampling as part of future groundwater monitoring since it is likely the onsite treated

groundwater will have perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) discharge requirements. The vapor intrusion pathway was evaluated in the RI and determined that unacceptable risk was not present.

EPA continues to implement the Site remedies and progress is being made on meeting the RAOs. Infrastructure funding should accelerate the cleanup activities on the Site.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No. The Site has not been impacted by any natural disasters or any changes related to climate change.

VI. ISSUES/RECOMMENDATIONS

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 1	Issue Category: Monitoring			
	Issue: PFAS sampling, at the request of EGLE, needs to be completed since PFAS will likely have a water treatment plant discharge criterion.			
	Recommendation: Sample groundwater for PFAS compounds to assist in the design of the water treatment plant.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA/State	EPA/State	12/31/2022

OU(s): 2	Issue Category: Monitoring			
	Issue: Long-term monitoring of DDT levels in fish and sediment adjacent to the Site and in the St. Louis Impoundment is needed			
	Recommendation: Develop and implement a long-term monitoring plan for DDT levels in fish tissue and sediment			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA/State	EPA/State	12/31/2026

OU(s): 1, 2	Issue Category: Institutional Controls			
	Issue: An ICIAP is needed to ensure that effective ICs are implemented, monitored and maintained			
	Recommendation: Develop and submit an ICIAP which describes the plan for ensuring that all required ICs at the site are implemented, and for ensuring that all ICs, once implemented, are monitored and maintained			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA/State	EPA/State	12/31/2027

OTHER FINDINGS

In addition, the following recommendation was identified during the FYR and may accelerate site close out, but does not affect current nor future protectiveness:

- Evaluate ways to concurrently implement multiple remedial actions due to an increase in remedial action funding.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
<i>Operable Unit: 1</i>	<i>Protectiveness Determination:</i> Will be Protective
<i>Protectiveness Statement:</i> The remedy at OU1 is expected to be protective once all the remedy components are completed. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas. The residential ANP cleanup, the City of St. Louis change to the Gratiot Area Water Authority drinking water supply and the treatment of Area 1 and Area 2 by ISTT are complete, but the implementations of other remedy components have not begun.	

Protectiveness Statement(s)	
<i>Operable Unit: 2</i>	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The remedy at OU2 currently protects human health and the environment because removal of contaminated sediments in the Pine River and the installation of a collection trench system adjacent to the river has resulted in over a 98% reduction of DDT levels in fish tissue. The significant reductions in DDT exposures to fish are anticipated to result in the reduction of DDT levels in fish and eventual elimination of the existing fish consumption advisories. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: develop and implement a long-term monitoring plan for DDT levels in fish tissue and sediment; and	

develop and submit an ICIAP which describes the plan for ensuring that all required ICs at the site are implemented, and for ensuring that all ICs, once implemented, are monitored and maintained.

Sitewide Protectiveness Statement

Protectiveness Determination:
Will be Protective

Protectiveness Statement: The remedy at the Site is expected to be protective once the remaining remedy components have been implemented. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas. The residential ANP cleanup, the ISTT and the City of St. Louis change to the Gratiot Area Water Authority drinking water supply are complete. The removal of contaminated sediments in the Pine River and the installation of a collection trench system adjacent to the river has resulted in over a 98% reduction of DDT levels in fish tissue. The SWAC for DDT of 1.38 ppm should result in safe DDT levels in fish and eventual elimination of the existing fish consumption guidelines.

VIII. NEXT REVIEW

The next FYR report for the Velsicol Chemical Corp. (Michigan) Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

- US District Court. 1982. Consent Judgment for the Velsicol Chemical Company Site. December 27. (SEMS 83515)
- CRA. 1986. Post Closure Maintenance and Monitoring Plan for St. Louis Plant. March 1. (SEMS 83232)
- USDHHS/USPHS/ATSDR. 1989. Preliminary Health Assessment for the Velsicol Chemical Corporation (St. Louis Plant Site). June 1. (SEMS 83516)
- EPA. 1995. Final Close-out Report. September 25. (SEMS 946109)
- USDHHS/USPHS/ATSDR. 1993. Site Review and Update for the Velsicol Chemical Site. September 30. (SEMS 83523)
- Memphis Environmental Center, Inc. 1997. Containment System Assessment Report – Volumes 1 & 2. October 1. (SEMS 83593 & 83596)
- CRA. 1997. Work Plan: Post-Closure Cap Maintenance for the former Michigan Chemical Plant Site. December 1. (SEMS 83598)
- EPA. 1998. Action Memorandum for Time-Critical Removal Action at the Velsicol Site. June 9. (SEMS 83605)
- EPA. 1998. Streamlined Remedial Investigation Report for the Velsicol Chemical Site. August 1. (SEMS 83607)
- E&E. 1999. Treatability Study for the Velsicol/Pine River Site, Volumes 1 and 2). February 4. (SEMS 83631 & 83636)
- EPA. 1999. Record of Decision for Operable Unit 2 (Pine River) at the Velsicol Chemical Superfund Site. February 12. (SEMS 83639)
- CH2M. 2005. Final Source Migration Investigation Report for Operable Unit 1 at the Velsicol Chemical/Pine River Site. November 1. (SEMS 417354)
- Weston. 2006. Remedial Investigation Report for OU1 at the Velsicol Chemical Corporation Site. November 1. (SEMS 303106 – 303113, 405576 – 405779)
- Weston. 2009. Remedial Investigation Addendum Report for OU1 at the Velsicol Chemical Site. January 1. (SEMS 311456, 405580 – 405583)
- CH2M. 2010. Remedial Action Report for OU2 at the Velsicol Chemical Site. April 10. (SEMS 919607)
- Weston. 2011. Feasibility study for OU1 at the Velsicol Chemical Corporation Site. November 1. (SEMS 417361 – 417368)
- EPA. Proposed Plan for Operable Unit 1 at the Velsicol Chemical Superfund Site. February 5. (SEMS 424068)

EPA. 2012. Record of Decision for OU1 at the Velsicol Chemical Corporation Site. June 22. (SEMS 410943)

CH2M. 2014. Fact Sheet on Pine River Fish Monitoring - Community Information Update. May 1.

CH2M. 2016. Final Data Evaluation Report for PSA 3 and 4. May 1.

CH2M. 2016. Phase 1 and Phase 2 Remedial Action Report for the Adjacent and Nearby Properties. June 1. (SEMS 928115)

CH2M. 2016. Phase 3 Remedial Action Report for the Adjacent and Nearby Properties. September 1.

CH2M. 2019. Remedial Action Report for the In-situ Thermal Treatment of Area 1 at the Velsicol Chemical Superfund site. March 1.

CH2M. 2019. Upgradient Slurry Wall Investigation Work Plan August 28.

CH2M. 2017. Final Report for the Velsicol Flow Model – 2016 update. July 1. (SEMS 935051)

EGLE. 2017. Caged Fish Study of the Pine, Tittabawassee, and Saginaw Rivers – September 20, 2017 to October 18, 2017.

CH2M. 2020. Technical Memorandum Recommending the Design Approach for Potential Source Area 3. June 8. (SEMS 956226)

CH2M. 2020. Technical Memorandum for the Evaluation of the Applicability for the Implementation of ISCO Treatment Technology in PSA-4. June 8. (SEMS 958227)

CH2M. 2020. Data Evaluation Report for the Upgradient Slurry Wall Investigation, August 1. (SEMS 9625532)

CH2M. 2020. Technical Memorandum for Groundwater Monitoring. August 31. (SEMS 960555)

CH2M. 2021. Technical Memorandum for Supplemental Groundwater Characterization. January 22. (SEMS 963617)

CH2M. 2022. MW-19 Investigation Work Plan, February 1. (SEMS 973779)

CH2M. 2022. Supplemental Upgradient Slurry Wall Investigation Work Plan. February 16

CH2M. 2022. Investigation Work Plain for the Perimeter Drain Investigation. May 1.

APPENDIX B - SITE BACKGROUND AND CHRONOLOGY

History of Contamination

The 52-acre FPS was used for industrial operations since the mid-1800s, including a lumber mill, oil refinery, salt plant, and chemical plant. Michigan Chemical Corporation (MCC) purchased the facility in 1935 and operated a chemical manufacturing business until 1977, when MCC merged with Velsicol Chemical Corporation (Velsicol). From 1936 through 1977, the plant manufactured a variety of organic and inorganic chemicals, including polybrominated biphenyls (PBB), hexabromobenzene (HBB), dichlorodiphenyltrichloroethane (DDT), and tris(2,3-dibromopropyl)phosphate (TRIS). The plant was closed in 1977 and decommissioning activities were initiated in 1978. The plant site represented a threat to public health, welfare, and the environment because of widespread contamination caused by poor waste management practices and direct discharges of process wastes to the adjacent Pine River. Prior to the site's listing on the NPL, a number of pre-NPL responses were conducted from 1978 through 1983, including site characterization investigations, site inspections, and a preliminary assessment. The Site was proposed for inclusion on the NPL on December 30, 1982 and appeared on the final NPL on September 8, 1983.

The Site has been the subject of a number of investigations over the years conducted by EGLE (and its predecessor, MDNR, the Michigan Department of Natural Resources), Velsicol, and EPA. Some of those investigations will be discussed later in this appendix.

Initial Response

Initial remedial measures for the site began in October 1978 with plant closure and decommissioning activities, cessation of process discharges to the Pine River, and demolition of buildings and structures on the FPS. Initial site characterization activities began in 1978 and continued through 1980. Those early studies revealed contamination in site soils, groundwater, river sediments, and fish. Pine River surface water did not contain measurable levels of contaminants associated with the site.

Based on those early studies, EPA and the State of Michigan negotiated and entered into a Consent Judgment (CJ) with Velsicol in 1982 for a remedy directed at stopping the migration of PBB, HBB, DDT and other Site contaminants from the FPS into the environment. Under the CJ, Velsicol agreed to contain in place the 52-acre FPS and to pay \$13.5 million to Michigan for remediation of the Gratiot County landfill and \$500,000 to the Superfund. Under the CJ, Velsicol also agreed to excavate contaminated soil from the former burn pit area and to place those materials on the FPS, inside the containment system. The parties to the CJ concluded at the time that the most appropriate alternative for the Pine River sediments was to leave them in place. The CJ released Velsicol from liability for cleanup of the sediments that were contaminated at the time of entry of the CJ or sediments that became contaminated from reasonably foreseeable migration or discharge from the FPS prior to completion of the containment system.

The 1982 CJ required Velsicol to construct a containment system for the FPS comprised of a 2-foot thick, low permeability slurry wall around the facility and a 3-foot thick, low permeability clay cap on top. The CJ also required Velsicol to maintain groundwater levels within the containment system through pumping and off-site deep well injection along with conducting long-term operation and maintenance (O&M) activities at the site. Velsicol began implementation of the CJ remedy in January

1983 and completed construction of the containment system in 1984. This work included excavating approximately 68,000 cubic yards of contaminated material from the former burn pit area (Golf Course site) and placing it on the FPS under the clay cap.

The FPS is now covered with shallow-rooted grass and is surrounded by a chain-link fence to restrict access.

As mentioned previously, the CJ did not require Velsicol to remove the contaminated sediments from the Pine River. A 1989 Preliminary Health Assessment prepared by the Michigan Department of Public Health (MDPH) and the Agency for Toxic Substances and Disease Registry (ATSDR) concluded that the river posed a potential public health concern because of possible human exposure to contaminants via ingestion of fish and direct contact with river sediments. The concern regarding potential fish consumption was reiterated in 1993 in an MDPH/ATSDR Site Review and Update. The State of Michigan addressed the concern regarding contamination of fish in the river by issuing health advisories. A no-consumption advisory for all species of fish was initially published in the Michigan fishing guides in 1977, and the no-consumption advisory, which affects 33 miles of the Pine River, is still in effect.

Velsicol operated and maintained the Site in accordance with the approved O&M plan, and water levels inside the containment system remained below the level set by the 1982 CJ until February 1993. From 1993 to mid-1998, Velsicol had to pump water from the containment system and dispose of the water offsite in order to maintain the water levels within the containment system below the level established by the CJ.

In late 1994, the State of Michigan collected fish samples and noted that the average concentration of total DDT in skin-off filet carp samples (23.3 parts per million (ppm)) had more than doubled since 1989 (10.5 ppm). The State collected fish samples again in 1995 (16.1 ppm). The DDT concentrations in fish tissue coupled with the rising water levels inside the containment system caused concern that the containment system may have failed, increasing the loading of DDT into the Pine River.

OU1

Following the events noted above, EPA and EGLE asked Velsicol to conduct a comprehensive assessment of the containment system to ensure that it was not a source of DDT into the Pine River, and Velsicol agreed. At about the same time, EPA and EGLE reassessed the sediment contamination in the Pine River and decided to reconsider the no-action decision made in the 1982 CJ (see OU2 discussion below.)

In 1996, Velsicol completed its assessment of the containment system. Velsicol's assessment of the clay cap included collection and analysis of samples from the upper portion of the cap for permeability, grain size and Atterberg limits. Velsicol's assessment of the slurry wall consisted of installation of inclinometers inside and outside the slurry wall at seven locations, installation of settlement plates at seven locations inside the slurry wall, collection of samples at nine locations for permeability analysis, installation of upper zone piezometers on the inside and outside of the slurry wall at five locations, water level measurements and free product screening from all monitoring wells and piezometers, and a dye tracer study at the five locations where piezometers were installed. Velsicol documented the results of the containment system assessment in a report entitled *Final Containment System Assessment Report, Former Michigan Chemical Plant Site, St. Louis, Michigan* (Memphis Environmental Center - October

1, 1997).

EPA and EGLE agreed with Velsicol's containment system assessment document, which stated that the clay cap was leaking, most likely due to the absence of a frost protection layer on top of the cap. The document also concluded (based solely on water elevation measurements) that 94% of the water that was infiltrating the cap was migrating through the underlying clay till unit rather than moving laterally through the slurry wall. No obvious problems were documented with the slurry wall. Velsicol concluded in its report that the containment system was working as designed. In December 1997, Velsicol submitted a work plan entitled *Work Plan Post-Closure Cap Maintenance, Former Michigan Chemical Plant Site, St. Louis, Michigan*, in which Velsicol proposed to conduct maintenance of the clay cap during the summer of 1998 by recompacting areas of the cap. Velsicol decided to delay this work until EPA and EGLE completed the sediment removal project (discussed below). Both EPA and EGLE agreed to the delay. However, in December 1999 (while the sediment removal project was underway), Fruit of the Loom (FTL), and its subsidiary, NWI Land Management Inc., (NWI) filed for bankruptcy under Chapter 11. At that time, EPA and EGLE learned that NWI had become owner of the Site in 1986 through a complicated transaction including management buyout of Velsicol Chemical Corporation. Velsicol had been a subsidiary of FTL, but in 1986 became a separate company, and title to the Velsicol St. Louis site was transferred to NWI. Velsicol Corporation continued to manage the Site for NWI and FTL. When FTL filed for bankruptcy in 1999, it ceased payments to Velsicol for work at the Site; instead FTL's environmental firm, CEC, took over managing the site. FTL was not willing to repair the cap until the sediment remediation was completed. In 2002, EPA and Michigan settled their bankruptcy claims against FTL and NWI by accepting funding to a trust account from certain assets of the bankruptcy estate and from Velsicol. Velsicol was included in the bankruptcy settlement. The cap repair work was never done because, at this point, Michigan and EPA had initiated an investigation of the containment system at the FPS. In the bankruptcy settlement, FTL, NWI and Velsicol were released from CERCLA liability for the Site, and consequently there are no viable responsible parties at the Site to fund the remedial actions.

OU2

At about the same time as the containment system assessment for the FPS, EPA and EGLE began a reassessment of the contamination in the Pine River. During the summer of 1996, sediment cores were collected from 23 locations in the St. Louis Impoundment and analyzed for PBB, HBB and DDT. Surficial sediment samples were also collected from depositional areas in the lower Pine River (below the St. Louis dam). During the summer 1997, EPA and EGLE collected another round of sediment cores from 28 locations and analyzed them for DDT and total organic carbon. EGLE also collected fish for analysis.

In June 1998, EPA signed an Action Memorandum for a time-critical removal action to remove the most highly contaminated sediments from the Pine River (OU2). The removal action included excavating contaminated sediments containing 3,000 ppm total DDT or greater from an area now known as the hot spot cell. EPA carried out the removal action by installing sheet piling around the most highly contaminated sediments to create the cell, dewatering the cell, treating the sediments with a stabilizing/drying agent, excavating the DDT-contaminated sediments, and disposing of them offsite. The removal action also included building necessary infrastructure such as roads, a staging pad, and a water treatment plant. EPA's removal action at the hot spot cell began in August 1998 and was completed in October 1999, and it resulted in the removal of approximately 30,000 cubic yards of sediments from the river. In February 1999, following completion of a streamlined RI/FS for the Pine

River, EPA signed a ROD for OU2.

The selected remedy included hydraulic modification of the Pine River, excavation of sediments containing greater than 5 ppm total DDT, dewatering and water treatment, and disposal of the contaminated sediments in either a RCRA Subtitle D or Subtitle C landfill.

Following the February 1999 ROD for OU2, EPA started remedial design work in March 1999 and began remedial action work in May 1999, with actual onsite construction work beginning in October 1999 as the time-critical removal action work at the hot spot cell was being completed. All remedial design work was completed by September 2003.

The remedial action work for OU2 was conducted in phases, with Phase I addressing the sediments in the southern half of the Pine River immediately adjacent to the former plant site and Phase II addressing sediments in the river's northern portion and Mill Pond. Various remedial cells were constructed of sheet piling during each phase. Similar to the prior removal action work, the remedial action work for OU2 involved dewatering within the cells, treating the sediments with a stabilizing/drying agent, excavating the sediments and disposing of them offsite. The remedial action work also included treating the water removed from the cells at the onsite treatment plant after first being pumped to an equalization basin.

Phase I work was conducted from 1999 to 2003, and Phase II work was conducted from 2003 through 2005. The infrastructure in the river, such as the haul road, equalization basin and steel sheet piling, was removed during 2006, with remedial action construction activities completed in November 2006. The remedial action will be considered officially complete when EPA approves the final Remedial Action Report. The remedial action at OU2 removed an estimated 640,000 cubic yards of DDT-contaminated sediments, and an estimated 222 tons of DDT, from the Pine River.

During the 2001 construction season EPA observed seepage from the riverbank adjacent to the FPS into the hot spot cell, and during both the 2001 and 2002 construction seasons EPA discovered that, in some areas, sand seams on top of and within the glacial till underlying the Pine River contained DNAPL. Two distinct types of DNAPL were identified: one containing primarily DDT and chlorobenzene ("hot spot cell DNAPL") and a second containing primarily brominated and other halogenated organic compounds, with very small amounts of DDT ("Area 3 DNAPL").

Following these discoveries, EPA decided to take an interim response action to prevent DNAPL and contaminated groundwater from seeping from the FPS into the remediated areas of the Pine River. EPA installed DNAPL collection trenches along the southern shoreline of the Pine River, and also pumped DNAPL directly from pooled areas on the exposed glacial till. In 2002 alone, EPA removed 3,275 gallons of DNAPL from the subsurface of the riverbed. EPA removed 4,355 gallons of DNAPL during the sediment cleanup.

Most of the DNAPL collection system was installed during the 2002 construction season, but an additional segment was installed during 2006 along the shoreline in the former equalization basin. The DNAPL collection system consists of a series of main trench segments along the shoreline, with trench laterals extending toward the center of the river perpendicular to the shoreline. A manhole with a 3-foot sump was installed in the middle of each main trench segment to facilitate removal of DNAPL by pumping. Construction details of the DNAPL collection system are provided in the *2006 Cleanup Status Report* (CH2M HILL, 2006).

Typically, following dewatering, 10 to 13 feet of contaminated sediment were present in a remedial cell, underlain by 1 to 3 feet of sand. Very dense glacial till was present below the sand. Usually, after all the sediment and sand were removed, confirmation sampling of the underlying glacial till showed remaining total DDT concentrations were less than the cleanup level of 5 ppm.⁵ In some instances, some minor scraping of the till surface was necessary to meet the total DDT cleanup standard. In other cases (especially in the hot spot cell and Area 3), the glacial till was heavily contaminated by DNAPL, and complete excavation of DNAPL-affected till was infeasible because of concerns about the stability of the sheet pile wall and breaching the lower aquifer. In these areas, final confirmation samples typically were not collected, and the till was capped with 2 feet of imported clay. Additionally, clean earth fill was used to backfill all sheet pile walls where sediment excavation had exposed the face of the wall. This clean earth fill was left in place when the sheet piling was removed.

As mentioned previously, the ROD anticipated that all sediments at and above 5 ppm total DDT would be removed from the river. Even in the areas where NAPL-impacted till was discovered, all contaminated sediments were removed. The only area of OU2 where contaminated sediments were not removed is an area of the river known as "Area 2." Area 2 is located along the southern edge of the river from just west of the Mill Street Bridge to the dam at the southeastern portion of the Mill Pond. Sample results showed that this area contained minimal concentrations of DDT contamination, and engineering design considerations determined that the area would be very difficult to work in due to Area 2 being in close proximity to the St. Louis hydroelectric dam. As a result, Area 2 was excluded from the cleanup. The average surficial DDT concentration in Area 2 is 13.8 ppm, and the average concentration for the entire sediment column is 15.7 ppm total DDT. An estimated 26,000 cubic yards of sediments remain in Area 2.

Based on concerns regarding failure of the containment system for OU1, EGLE initiated RI planning activities in April 2000 and began RI fieldwork in September 2001 to assess the containment system and the nature and extent of contamination at OU1.

OU1 Revisited

As noted above, EGLE initiated RI planning activities for OU1 in April 2000. EGLE conducted its RI work in a multi-phased approach, with the results of each phase of the investigation helping direct the investigations in subsequent phases. The initial phase of the investigation focused on evaluating the integrity of the slurry wall, with subsequent phases expanding the investigation to evaluate the nature and extent of the contamination across all media at and surrounding the main plant site, including soil, groundwater, soil gas, DNAPL areas and in the nearby residential areas surrounding the former plant site.

EGLE finalized and issued the RI Report for OU1 in November 2006 and subsequently completed a supplemental RI and issued the report in January 2009. The RI Report characterized the nature and extent of contamination at OU1 and found that significant contamination from volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, specialty chemicals, and inorganics exist in soil and groundwater at the FPS, and that soil in areas of the residential neighborhood adjacent to the main plant site contain concentrations of PBB and DDT above EGLE's Part 201 direct

⁵ Although the ROD for OU2 had not established cleanup criteria for the other contaminants of concern, confirmation samples were also analyzed for PBB and HBB. TRIS analysis was also initially conducted but was dropped after the 2000 construction season because TRIS was not detected in any of the 440 confirmation samples that year.

contact criteria and DDT above the ecological cleanup criteria. Vapor migration from groundwater to indoor air for residential, commercial/industrial worker and construction worker were also evaluated and did not show unacceptable risk. EGLE installed orange construction fencing around 11 locations in the residential area to prevent access to those areas. In addition to characterizing the nature and extent of contamination and the resulting risks to human health and the environment, the RI Report concluded that neither the clay cap nor the slurry wall meets the original design specifications, and neither are functioning as designed. Additionally, the report concluded that the slurry wall is not preventing the migration of contaminated groundwater from the FPS and that the containment system is therefore not protective of human health and the environment.

In conjunction with the State-lead RI fieldwork, EPA also conducted OU1 site investigation activities to supplement and support EGLE's work. EPA's work included a Source Migration Investigation (SMI) to investigate the presence and extent of NAPL contamination at the FPS. The primary fieldwork for the SMI was conducted from September 2004 through July 2005, and the SMI Report was finalized in November 2005. The SMI was intended to support the RI by determining the distribution of DNAPL at the FPS, the extent of DNAPL mobility in the subsurface, and the extent of groundwater contamination resulting from DNAPL migration. As part of the SMI, EPA sampled the City of St. Louis water supply wells in September 2004 and some private residential wells. No contamination was detected in the residential wells. The chemical para-chlorobenzene sulfonic acid (pCBSA), a byproduct of the DDT manufacturing process, was detected in some of the city wells, including wells #1 and #4 (the closest to the Site). pCBSA is highly soluble in groundwater and is resistant to natural degradation, making it very mobile in groundwater and a useful indicator of contaminant movement. EGLE subsequently established a drinking water-based Part 201 cleanup criterion for pCBSA (7,300 ppb). EPA was routinely monitoring the city wells and certain site monitoring wells for pCBSA and other Site-related contaminants, but that sampling stopped in 2012. The highest levels of pCBSA found in Site monitoring well MW30I, a well screened in the Intermediate aquifer and located east of the main plant site and south of the Pine River, along Mill Street. City wells #1 and #4 (which are screened in the Lower Unit aquifer) are located in the same general vicinity, approximately 300 feet from MW30I.

In February 2007, EPA completed installation of eight deep sentry monitoring wells screened in the same portion of the Lower Unit aquifer as the city wells to collect additional information about the geology and hydrogeology of the Lower Unit and to provide advance warning of potential impacts to the city wells from site-related contaminants. These wells are not being sampled at this time but may be part of a future monitoring network.

pCBSA was detected in all six city wells and was routinely detected in five of the wells. (The sixth well only had sporadic detections and, based on information gained during installation of the deep sentry monitoring wells, is believed to be upgradient of the Velsicol site.) The levels of pCBSA detected in the city wells were well below the state drinking water standard. The highest concentration detected in the city wells was in well #4 (460 ppb; March 2007) which is 15 times below the EGLE drinking water-based Part 201 cleanup criterion.

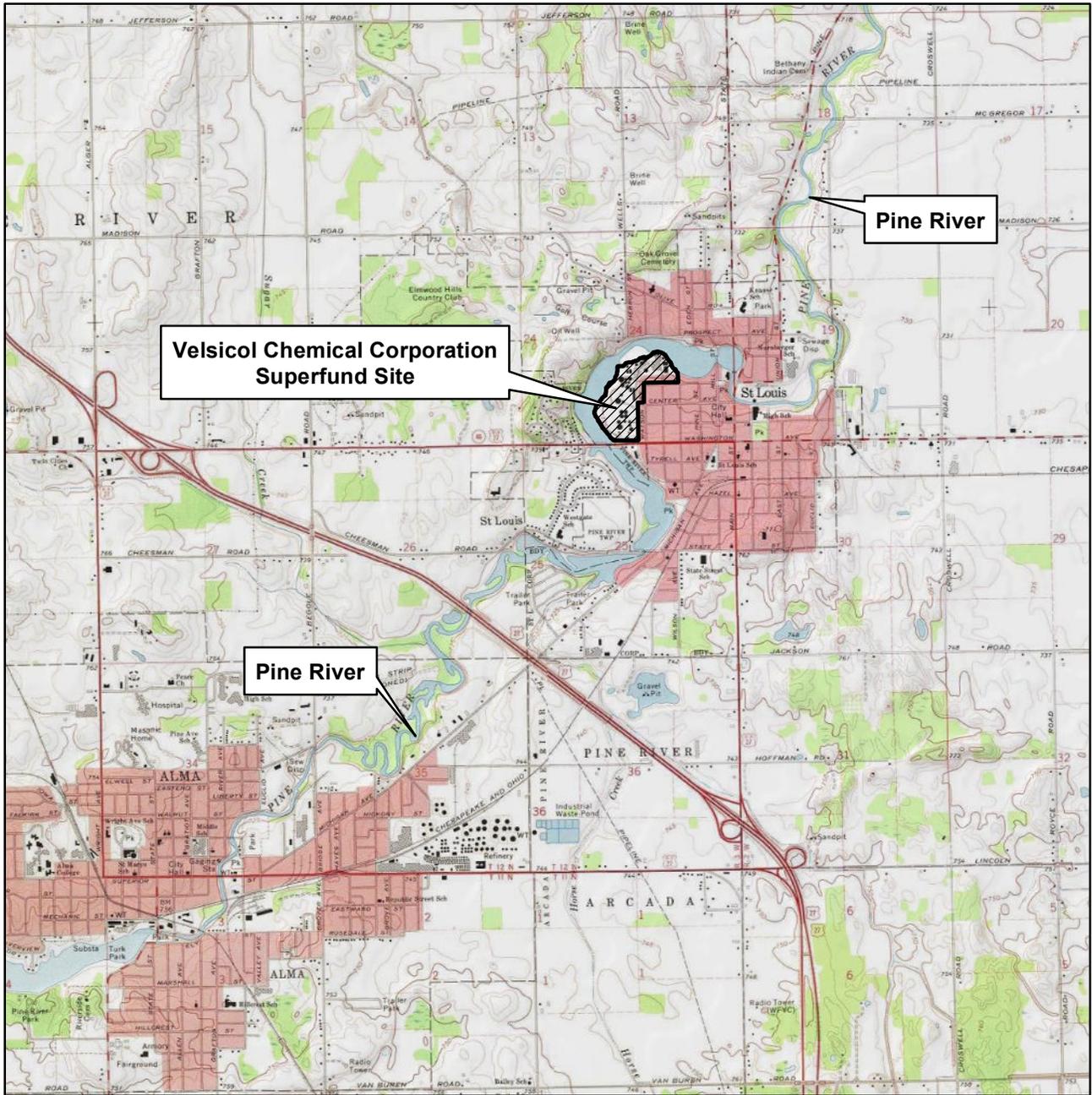
EGLE completed a Feasibility Study for OU1 and issued the report in November 2011. The Feasibility Study evaluated alternatives to address the contamination at the former plant site and residential area adjacent to the site. EPA issued the Proposed Plan for OU1 on February 7, 2012 and held a public meeting on February 16, 2012. After a 60-day public comment period, EPA issued a ROD for OU1 on June 22, 2012.

Chronology of Site Events

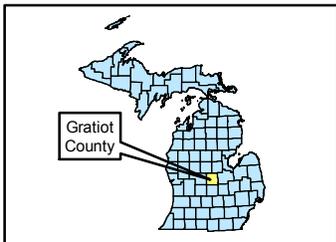
Event	Date
Initial discovery of problem or contamination	1978
Pre-NPL responses	1978-1983
NPL listing	September 8, 1983
Enforcement documents (Consent Judgment)	December 27, 1982
Remedial design start (FPS)	December 27, 1982
Remedial design complete (FPS)	January 27, 1983
Remedial action start (FPS)	January 27, 1983
Construction dates (start – finish; FPS)	January 1983 – November 1984
U.S. EPA removal assessment	February 1990 – June 1990
Construction completion date (date of final close-out report)	September 25, 1992
U.S. EPA removal assessment	May 1992 – September 1992
Final Close-Out Report	September 25, 1992
OU2 streamlined RI/FS start	February 14, 1997
First Five-Year Review	August 27, 1997
OU2 streamlined RI/FS complete	February 15, 1999
OU2 removal action start	August 3, 1998
OU2 removal action complete	October 20, 1999
Record of Decision for OU2	February 12, 1999
OU2 remedial design start	March 24, 1999
Superfund State Contract signature	April 20, 1999 (with subsequent amendments)
OU2 remedial action start	May 21, 1999
OU2 construction dates (start, finish)	October 1999 – November 2006
EGLE OU1 RI/FS start	September 2001
Second Five-Year Review	September 25, 2002
OU2 remedial design complete	September 29, 2003
EGLE RI Report released	November 2006
Third Five-Year Review	September 24, 2007

Event	Date
EGLE Phase 4 RI Report released	January 2009
EGLE Submits OU3 Baseline Assessment Report	March 2011
U.S. EPA Remedy Review Board Briefed OU1	May 2011
Remedial Action Report Approved for OU2	September 2011
EGLE FS Report released	November 2011
Proposed Plan released for OU1	February 2012
Record of Decision for OU1	June 22, 2012
OU1 remedial design start for in-situ thermal treatment, excavation of PSA 1&2	June 28, 2012
Pre-design work for groundwater treatment and ISCO begin	June 28, 2012
Fourth FYR	September 21, 2012
City begins construction of water replacement	Fall 2012
EGLE submits Pine River Baseline Assessment - Addendum	November 2012
Excavation of soil within orange fences completed (Phase 1)	December 2012
EPA begins RI/FS downstream (OU3)	May 2013
Phase 2 residential cleanup completed	December 2013
EPA completes removal of sheet pile wall in Pine River	March 2015
EPA begins removal action in athletic fields downstream	May 2015
Phase 3 residential cleanup complete	July 2015
EPA completes design for ISTT Area 1	September 2015
City begins using GAWA drinking water	October 2015
EPA begins site preparation activities	October 2016
EPA receives Superfund Trust Fund funding for ISTT of Area 1	July 2017
EPA completes Area 1, Area 2 Phase 1 and Area 2 Phase 2 ISTT	January 2022

APPENDIX C – FIGURES



SOURCE: ESRI USA Topo Maps Service



Legend

 Former Main Plant Site

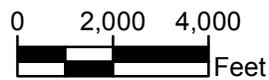


Figure: 1

Designed by: KRB

Drawn by: KRB

Checked by: RCD

Approved by: RCD

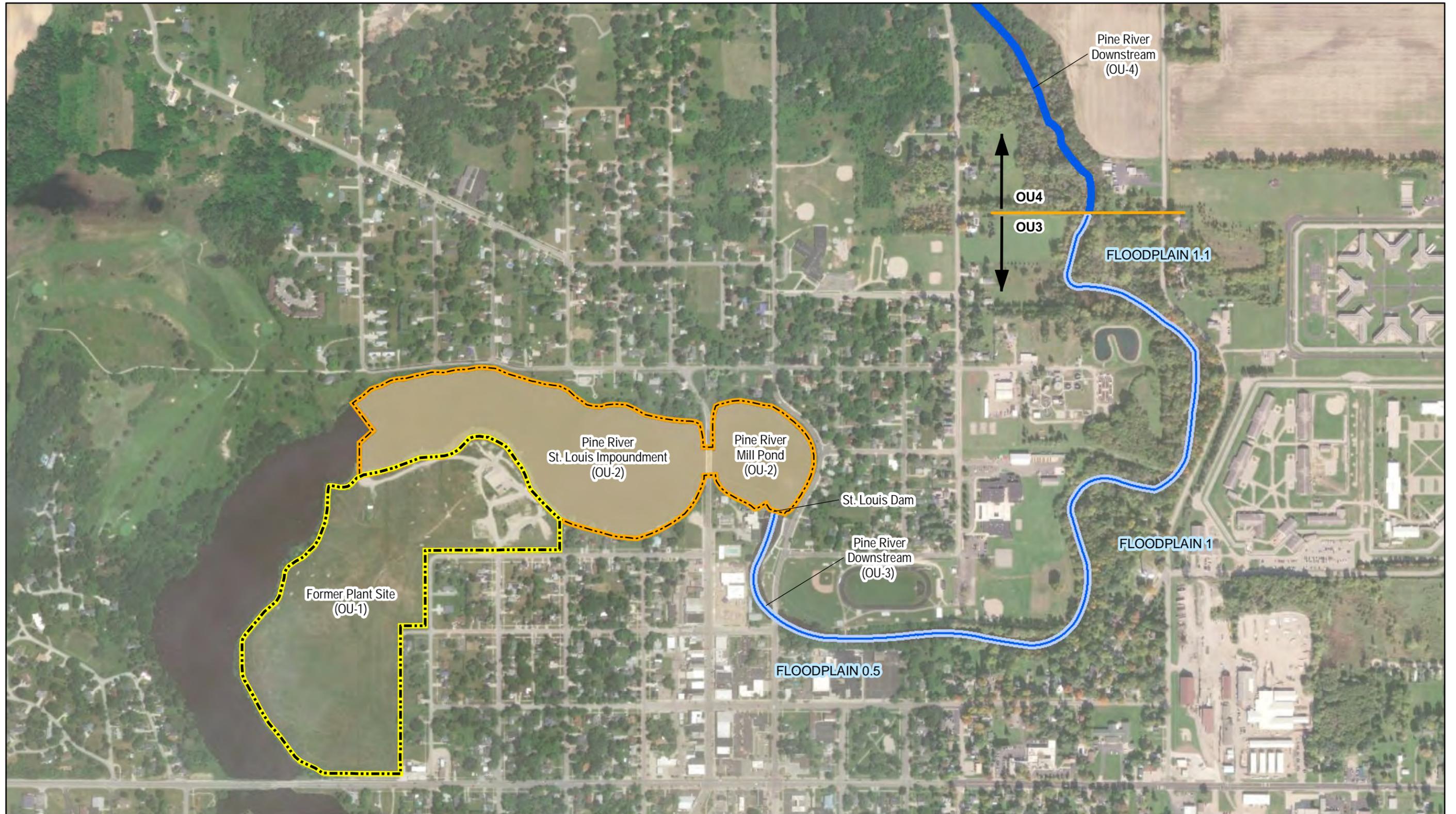


Michigan Department of Environmental Quality
Remediation and Redevelopment Division
Superfund Section



Weston Solutions of Michigan, Inc.
2501 Jolly Road, Suite 100
Okemos, Michigan

SITE LOCATION MAP
Pine River Baseline Assessment
2012 Addendum
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan



Legend

-  Former Plant Site (OU-1)
-  Pine River - St. Louis Impoundment (OU-2)
-  Pine River (OU3)
-  Pine River (OU4)

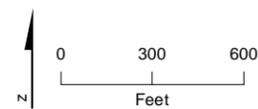


Figure 2
 Study Areas and Operable Units
 OU3 Focused Feasibility Study
 Velsicol Chemical Corporation Superfund Site
 St. Louis, Michigan



APPENDIX D – 2018 FISH TISSUE RESULTS

Location	Collection Date	Species	Sex	Length(cm)	Weight(g)	Mercury (ppm)	gcod	PFOS (ppb)
St. Louis Impoundment	18-Jul-18	Bluegill	F	15.6	85	0.082		1.32
St. Louis Impoundment	18-Jul-18	Bluegill	F	16.1	95	0.073		1.05
St. Louis Impoundment	18-Jul-18	Bluegill	F	16.9	110	0.064		2.78
St. Louis Impoundment	18-Jul-18	Bluegill	F	16.6	95	0.048		2
St. Louis Impoundment	18-Jul-18	Bluegill	F	17.9	95	0.064		1.61
St. Louis Impoundment	18-Jul-18	Bluegill	F	17.7	110	0.11		2.13
St. Louis Impoundment	18-Jul-18	Bluegill	M	18.2	130	0.053		0.25
St. Louis Impoundment	18-Jul-18	Bluegill	M	18.2	130	0.074		2.82
St. Louis Impoundment	18-Jul-18	Bluegill	F	18.6	130	0.067		2.25
St. Louis Impoundment	18-Jul-18	Bluegill	M	19.1	165	0.039		4.62
						Mean	0.1	2.1
						s	0.02	1.19
						s.e.	0.01	0.38
						95% UCL	0.12	2.96
St. Louis Impoundment	18-Jul-18	Largemouth Bass	M	31.2	545	0.15		7.79
St. Louis Impoundment	18-Jul-18	Largemouth Bass	M	31.6	595	0.18		8.62
St. Louis Impoundment	18-Jul-18	Largemouth Bass	M	33.5	595	0.17		11
St. Louis Impoundment	18-Jul-18	Largemouth Bass	F	32.3	615	0.13		7.33
St. Louis Impoundment	18-Jul-18	Largemouth Bass	M	35.7	805	0.34		5.03
St. Louis Impoundment	18-Jul-18	Largemouth Bass	F	45.2	1625	0.39		7.53
St. Louis Impoundment	18-Jul-18	Smallmouth Bass	F	33.3	510	0.26		5.64
St. Louis Impoundment	18-Jul-18	Smallmouth Bass	M	36.1	715	0.19		10.2
St. Louis Impoundment	18-Jul-18	Smallmouth Bass	F	42.6	1330	0.55		2.39
St. Louis Impoundment	18-Jul-18	Smallmouth Bass	F	43.5	1410	0.28		3.47
						Mean	0.3	6.9
						s	0.13	2.77
						s.e.	0.04	0.88
						95% UCL	0.39	8.89